CHEMISTRY 101: MOLECULAR STRUCTURE AND PROPERTIES

Fall 2013

Prof. Juliane L. Fry
318 Chemistry, x7951, fry@reed.edu
Office Hrs: Mon & Tues 3-4:30 pm

Prof. Margret J. Geselbracht
309 Chemistry, x7865, mgeselbr@reed.edu
Office Hrs: Mon 2-4 PM or by appointment

LECTURE F01: MWF 10-10:50 AM (PSYCH 105)
AFFILIATED CONFERENCE SECTIONS

F11 Wed: 1:10–2:00 PM (Chem 105)
F12 Wed: 2:10–3:00 PM (Chem 105)
F13 Thurs: 11:00–11:50 AM (Chem 105)
F14 Thurs: 3:10–4:00 PM (Chem 105)

LECTURE F02: MWF 11-11:50 AM (VLH)
AFFILIATED CONFERENCE SECTIONS

F21 Wed: 3:10–4:00 PM (Chem 105)
F22 Wed: 4:10–5:00 PM (Chem 105)
F23 Thurs: 1:10–2:00 PM (Chem 105)
F24 Thurs: 2:10–3:00 PM (Chem 105)

Lab coordinator: Dr. Danielle Cass
308A Chemistry, x4618, dcass@reed.edu
Office Hrs: Mon 11-1; Thurs 12-1:30
Lab instructor: Dr. Wendy Breyer
209A Chemistry, x7893, breyerw@reed.edu
Office Hrs: Tues 2-3 pm

LABORATORY SECTIONS
Labs begin with pre-lab lecture in these rooms:

FL1 Mon: 2:10–5:00 PM, Chem 301
FL2 Tues: 9:00–11:50 AM, Phys 122
FL3 Tues: 1:10–4:00 PM, Chem 301
FL4 Wed: 1:10–4:00 PM, Chem 301
FL5 Thurs: 9:00–11:50 AM, Phys 122
FL6 Thurs: 1:10–4:00 PM, Chem 301
FL7 Fri: 2:10–5:00 PM, Chem 301

SAFETY LECTURES (Week 1)
Please sign up on the Moodle and attend ONE session. These will last ~2 hours.
Tuesday, Sept 3rd, 11:10 am in Vollum Lecture Hall
Wednesday, Sept 4th, 6:10 pm, Biology room 19
Thursday, Sept 5th, 11:10 am, Physics room 240A
Friday, Sept 6th, 2:10 pm, Psychology room 105

REQUESTS FOR SECTION CHANGES:
Your choice of conference section must match the lecture section listed above it! If you need to change conference and/or lecture sections, ***please bring a Change of Section form, available from the Registrar's Office, to Julie or Maggie*** (the instructor that you wish to switch to). If you need to change lab sections, ***please see Danielle with a Change of Section form***. We will do our best to accommodate your requests, but bear with us as we do have a maximum enrollment cap allowed per section.

CHEM 101 MOODLE: If you are enrolled in the course, you will automatically be enrolled in the Chem 101 Moodle (https://moodle.reed.edu). The Moodle acts as "the command center" for the course. Here you will find electronic copies of all course documents, assignments, weekly announcements, reading assignments, suggested book problems, discussion forums, and links to helpful external resources. Periodically, we will post class announcements to the News Forum, and you will all receive copies of News Forum posts by e-mail. ***We will assume you will be checking your Reed e-mail account regularly.***

There is also a Chem 101 Questions and Discussions Moodle forum where anyone can post questions or comments about lecture, conference, problem sets, lab reports, etc. We will be monitoring this Forum to answer questions or post tips in a timely fashion, but feel free to comment on what your fellow classmates are writing as well. If you have a question, consider posting it to the Forum rather than e-mailing us personally as it is very likely that someone else may be puzzled by the same thing.

TEXTS:
CHEMISTRY: The Science in Context, 3rd Ed. **by Gilbert, Kirss, Foster &Davies** (REQUIRED)
The bookstore has worked hard to save you some money, and there is a new option: This text is available used from the bookstore, both hardcover and paperback ($70) or as an eBook (2 years access) for $52 (see link on Chem 101 Moodle). There are also 5 hard copies on library reserve.

***Chemical Bonding* by Mark I. Winter** (Recommended)
This book in the Oxford Chemical Primers series is a nice companion text that reviews atomic structure, Lewis structures, molecular geometry, and simple bonding models. There are 5 copies on library reserve.

Module Student Manuals (On reserve)
Much of our curriculum this fall was inspired by two "Module Student Manuals," used in the past as companion texts. Printed copies of the "What's in a Star?" and "Would You Like Fries With That?" module student manuals are available on library reserve. These student manuals provide additional background information and many activities that we have adapted for lecture, conference, or labs.

CHEM 101 LABORATORY:
We have designed activities for the Chem 101 laboratory that complement the topics that we will be covering in lecture. Labs will meet weekly **beginning the second week of classes, Monday, Sept. 9**. Attendance at lab is mandatory. If illness or another emergency prevents you from attending lab, please contact your lab instructor by phone or e-mail as soon as possible. If your reason for missing lab is a documented valid excuse (oversleeping is not a valid excuse), we will try to arrange a make-up lab during the same week.

CHEM 101 LAB MANUAL:
The **Chem 101 Lab Manual** will be available for purchase from the Chemistry stockroom (Chem 212) for $5. Each week, please read the experiment and complete the pre-lab preparation before coming to lab. You will also need to purchase a **BOUND** laboratory notebook (we recommend a quad-ruled Composition Book). Each week, you need to bring the lab manual and your lab notebook with you to your lab section.

LABORATORY SAFETY LECTURE:
Everyone must sign up to attend one of the safety lectures this week; times and locations are listed on the first page of this syllabus and sign-up is on the Chem 101 Moodle. Additionally, you must pick up a **SAFETY MANUAL** (available from the Chemistry stockroom, Chem 212) **and read Chapters 1–3 and 6–8. You must complete the safety quiz on page 49 of the Safety Manual and bring it to lab the week of Sept 9.** Do not sign the backside of the form until lab; your lab instructor will act as the witness.

CHEM 101 CONFERENCE:
Conference is a crucial component of this course. It is an opportunity to engage the course material more actively through discussion, small group problem solving, computer modeling, and hands-on activities. It is also a great place to interact with faculty and to get help when you are having difficulties. We **expect** regular attendance and participation.

CLICKERS IN CHEM 101:
We will be using course response systems or "clickers" in Chem 101. Our goals in using this technology are: (1) to provide a more active and engaged experience for students in lecture, (2) to gain real-time assessment of your learning in the course, and (3) to provide immediate feedback to faculty on which concepts need more discussion. Each student will be expected to purchase and register their clicker and bring it with them to every lecture. Several clicker questions will be distributed throughout each lecture and you will receive participation points for registering your answers. Not choosing to participate or repeatedly forgetting your clicker may have a detrimental effect on your semester grade. These are points that are entirely under your control. Take charge of your learning!

Each student must purchase and register a clicker for use in Chem 101 by Monday, Sept. 9. Clickers are available at the bookstore for purchase or rental (in the past, clickers have been used in Chem 101/102, Chem 201, and Chem 212). It is your responsibility to make sure your clicker is functional. The bookstore will be handling battery replacement and all clicker repair issues. A link on the Moodle points to a form to register your clicker number, for which the deadline is also Monday, Sept. 9. This way, your responses will be registered to you in our software.

A FEW WORDS ABOUT OUR GOALS FOR CHEM 101:

We recognize that you are an extremely diverse group of students in Chem 101. You have a wide range of backgrounds and prior experience with chemistry. You vary in the reasons for taking this class. Some of you are potential science majors, some of you have ambitions of medical school, some are motivated by a basic curiosity about chemistry, and yes, some of you just need the credit for Group C. Because of this, you all have different goals for what you would like to take away from this course.

Our goals for Chem 101 are simple. We hope that all of you succeed and that you enjoy the experience! But here are some more specifics:

Learning Goals. *By the end of Chem 101, you should be able to:*

- Make connections between observations of the macroscopic natural world and behavior at the atomic and molecular level.
- Use theories and models as unifying principles to understand and make predictions about natural phenomena.
- Analyze complex, multi-step problems that connect symbolic quantitative relationships with atomic and molecular level descriptions of chemical behavior and determine appropriate problem-solving strategies.
- Collect and analyze observations and quantitative data in the laboratory and communicate findings in the appropriate scientific format.
- Describe the fundamental chemical principles behind astronomy, global warming, and health concerns about fats in our diet and understand the unique perspective a chemist contributes to these multidisciplinary fields of interest.
- Evaluate the credibility, use, and misuse of scientific and quantitative information in reports to the general public on scientific research and public-policy issues.

EVALUATION:

To *succeed* in this course, you need to exhibit sustained effort and achievement in all of the following:

3 In-Class Exams (Friday, **September 27,** Monday, **November 4,** and Monday, **December 9**, 2013)
These will be 50 minutes long, taken in class with closed books and notes.

Final Exam (Sometime **December 16-19**, 2013: Date and time to be scheduled by the Registrar)
This will be a comprehensive exam reviewing the entire semester (again closed book, closed notes). **Do NOT make travel arrangements for winter break before the final exam is scheduled**. You must take the final exam when it is scheduled for your lecture section.

Problem Sets – Handed out on Wednesdays, due in lecture on Wednesday the following week or to the box in Kathy Kennedy's office (Chem 303) by 1 pm. **No late problem sets (after 1 pm) will be accepted without a documented medical excuse**. So, hand in whatever you have done even if it is incomplete. Some credit is better than no credit!

Clicker and Conference Participation – Regular attendance at lecture and conference and participation in clicker questions is expected.

Pre-lab quizzes and Lab Reports – Prior to each lab session, you must read the manual about the experiment and prepare your lab notebook. To ensure that all students are prepared, a brief pre-lab quiz must be completed on the Moodle prior to doing the lab. The quiz must be completed and will close 10 minutes before the start of lab. Lab reports throughout the semester will consist of less formal worksheets and more formal lab reports. Instructions for each lab report are provided in the Lab Manual. Reports and/or worksheets will be due on your scheduled lab day, typically one week after completion of the experiment. There is a 5% per day penalty for late reports, and no reports will be accepted more than one

week past the due date. *Note:* **If you do not turn in a *majority* of the laboratory reports, you will not pass this course, regardless of your exam scores.**

Practice Problems On Your Own – Learning Chemistry is akin to learning a language or learning to play a musical instrument. Practice, practice, practice is required to hone your skills! This means not simply reading the book and attending lecture, but working problems that apply your knowledge. For most students, just working the problem sets each week will ***not*** provide enough practice for you to succeed under the time pressures of an exam. We recommend that you work ***many*** more practice problems on your own to gain confidence and stretch your mind. In lecture, we will be suggesting end-of-chapter problems to work through on your own. These will not be collected. You should plan to set aside ***several hours per week*** to work extra problems.

This year we have an additional resource available to students seeking more problem-solving practice: SmartWork interactive online practice problems from the textbook publisher, W.W. Norton. Instructions for accessing these problems will be posted on the Chem 101 Moodle, including the required enrollment key and registration code, with which you will be able to access SmartWork free of charge since we are conducting a trial of this offering. These problems will also not be collected, and it is entirely up to you whether to use them to complement the book practice problems or not. If you choose to, we will be asking you at the end of the semester whether you found it helpful, to decide whether we integrate something like this more formally in future versions of this course.

ACADEMIC SUPPORT: (http://web.reed.edu/academic_support/)
At any point in the course, if you feel you need some extra help, there is a wide range of support available. We encourage you to first come to our office hours for help or arrange another time to meet with us that fits with your schedule. Individual tutors for Chem 101 are available and drop-in tutoring will be available at the DoJo from 5-11 pm Sun-Thurs. (For details, see http://dojo.reed.edu/schedule)

ACADEMIC COLLABORATION IN CHEM 101:
Your work and your behavior in Chem 101 are bound by the Honor Principle. All work submitted is expected to reflect the effort of the individual whose name appears at the top of the page.

You are encouraged to work with friends, tutors, and instructors on problem sets and lab reports. However, when the time comes to write this work up for submission, it must be your work, written in your own words and reflecting your understanding of the problems at hand. In lab, you will be working with a lab partner to complete the experiments. We hope you will discuss the meaning of the data you collect and the observations you make together with your partner. However, you will write up *individual* lab reports, reflecting your understanding of the experiment. Using the same words as your partner to answer a question on a worksheet is not acceptable. Composing a lab report at the computer together and submitting two copies with different names at the top is not acceptable. Sharing tables and plots with someone else to use as their own is not acceptable. We consider these are all forms of academic misconduct and/or dishonesty. If you have any questions about how much collaboration is acceptable or when the line of acceptable behavior is crossed, please ask your instructor!

All exams are to be taken closed book, closed notes and without any collaboration. In using a calculator, you may only use it for arithmetic and for simple algebraic and trigonometric functions. You may not use programmed equations or graphing functions during the exam period. You may not use a calculator on a smart phone during exams. Remember that full credit is given for demonstrating the thought process that leads to a correct response, not for simple answers without any demonstrated logic.

CHEM 101 COURSE OUTLINE:
The content of Chem 101 will be organized into 3 thematic modules. The purpose of each module is to place the chemistry content within the overall context of larger questions that may reach across several disciplines and/or have societal impact. Each module will be driven by a series of questions, and the chemistry will be taught on a need-to-know basis. The main consequence of this approach is that we will

not move through the textbook in a linear fashion. The modules, not the textbook outline, will guide the organization of the course. The underlying chemical theme of the fall semester is molecular structure and properties. Here is the contextual motivation and development of this theme, outlining the three modules:

1. WHAT'S IN A STAR? (SEPT/OCT)

What is starlight?
- Electromagnetic spectrum, dual nature of light

What do star colors tell us?
- Blackbody radiation, color, and temperature

What do stellar spectra tell us?
- Periodic trends in atomic properties and basic atomic structure
- Quantum mechanical wave model of atomic structure
- Using atomic spectroscopy to identify elements

What is the energy source behind a star?
- Mass and energy, fission, fusion

What is the origin of the universe?
- The Big Bang, nucleosynthesis

2. WHAT SHOULD WE DO ABOUT GLOBAL WARMING? (OCT)

Is the climate changing?

What is the relationship between CO_2 and temperature?

The global carbon cycle

What determines whether a gas is a greenhouse gas?
- Lewis structures, VSEPR, polarity, and infrared activity

How much are greenhouse gas concentrations changing?
- Atmospheric concentrations, global warming potentials

Why are greenhouse gas concentrations rising?
- Chemical equations and stoichiometry

3. WHAT'S ALL THIS FUSS ABOUT FATS IN OUR DIET? (NOV/DEC)

Is it unhealthy to eat fat?

What makes fats different from other nutrients?
- Chemical structures and properties of fats, carbs, proteins, vitamins

Why is fat a necessary nutrient?
- Molecular polarity and solubility

What kind of fat should we eat? Good fats vs. bad fats
- What's an omega-3?
- Geometric consequences of chemical bonding

Should we eat fake fat?
- The story of margarine, partial hydrogenation, and the evil trans-fats!

How is fat a concentrated energy source?
- Thermochemistry

4. BONUS MATERIAL: FROM BLUE JEANS TO BODY ARMOR (DEC)

Why are blue jeans made out of cotton and not polyester?
- Natural and synthetic polymers

How do I use chemistry to stop a speeding bullet?
- Polymer structure/property relationships

This will cover material from several chapters in *Chemistry*: *The Science in Context*, but due to our modular course structure, we will not move through the textbook in order. We also will skip some sections in these chapters that are not relevant or that you will return to in Chem 102. Background information on the module's context questions will be provided in course handouts. To help you keep track of where we are in the textbook, the Moodle has a page with weekly specific reading assignments and suggested practice problems that match the topics and the storyline of each thematic module.

LABORATORY SCHEDULE FALL 2013

Week of:	Experiment:	Report Due:
9/2	***SAFETY LECTURES***	
9/9	Exp 1: Introduction to Light, Color, and Spectroscopy	Exp 1 In-class worksheet due at the end of lab
9/16	Exp 2: Atomic Spectroscopy	Exp 1 Take-home worksheet in your Instructor's mailbox
9/23	Exp 3: Radioactive Decay	Exp 2 Take-home worksheet
	Exp 4A: Discovering Beer's Law	Exp 4A In-class worksheet due at end of the lab
9/30	Exp 4B,C: Discovering Beer's Law	Exp 3 report
10/7	Exp 5: Phosphate in the Willamette	Exp 4 report
10/14	Discussion of Exp 5	Exp 5 plots and data tables
	Set-up for Exp 6	
10/21	***FALL BREAK***	
10/28	Exp 6: Quantifying CO_2 production from Leaf Decay	
11/4	Exp 7: Separation and Identification of Leaf Pigments	Exp 6 worksheet
11/11	Exp 8: Hydrogenation of Cooking Oil, Part I	Exp 7 report
11/18	Exp 8: Hydrogenation of Cooking Oil, Part II	
11/25	***THANKSGIVING WEEK – NO LAB***	
12/2	Exp 9: Synthesis of Indigo	Exp 8 report
12/9	***NO LAB***	Exp 9 report